Richard Nakka's *Experimental Rocketry* Web Site

Links to Other Rocketry Resources

- Experimental Rocketry
- General Rocketry, Engineering & Science
- Resources
- Video Links
- Chemical Suppliers
- Tool, Hardware & Rocketry Suppliers

Experimental Rocketry

SugPro E-mail Discussion Group, maintained by Steve Peterson. SugPro is a new e-mail discussion forum that invites users to discuss all aspects of sugar-propellant rocketry. Ask questions, discuss your rocketry projects, tell us about your successes (and failures). Newbies and old-hands are welcome to join in this friendly discussion forum.

The Amateur Rocketry Link Library, maintained by Hans Olaf Toft. ARL Library is probably the best page on the net for amateur rocketry related web resources, including lots of useful downloadable software and links to every known experimental rocketry web site.

VRO Belgian Amateur Rocketry -- One of this group's projects is the development of a successful KN/Sorbitol/Sucrose motor. Other projects include a hydrogen peroxide/methanol motor, cast zinc/sulphur/aluminum propellant and AN composites. VRO

NERO is a long-standing Dutch amateur rocketry organization. Although their web site hasn't been updated in awhile, it still worthwhile to take a look, as this groups activities have encompassed many interesting aspects of rocketry. This includes KN-Sorbitol motors, AP composite motors, hybrid systems, electronic recovery systems, and motor test apparatus.

The experimenal rocketry web site of Guillermo Descalzo features a modified design of the B-200 rocket motor, fitted with BATES grain for longer burn time. In Spanish.

Stuart's Rocket Motor Development Pages
A new website, Stuart's site is a 'must see'...he features the design of a handsome 1/2 inch reusable aluminum motor. All of the parts are "turned" on his drill press. Included on his site are the technique for making fuel grains by rolling them out and cutting to length. His latest variation of the motor includes a Delay Element for parachute ejection.

DARK Danish Rocketry is DARK is the oldest rocket society in Denmark with more then 40 years of experience. DARK's mission is designing, building and testing rocket motors and complete rockets on a peaceful amateur basis. DARK has done some amazing rocketry work over the years that I have followed their progress. Absent from the web for a while, its good to see their valued presence on the web once again.

Recrystallized Rocketry is Jimmy Yawn's inimitable rocketry website. Jimmy has developed a novel method of preparing sucrose based propellants, based on recrystallization. But more than that, Jimmy is a highly devoted rocketry experimenter who has come up with a whole bevy of unique and clever motor making & testing techniques.

Bulgarian Rocketry Forum
Discussion forum dealing with all aspects of Experimental Rocketry. Currently in Bulgarian language only.

GCCE (Grupo Cientifico de Coheteria Experimental)
An extensive and well-documented Spanish website devoted exclusively to amateur experimental rocketry, aimed at designing, developing and the building of experimental rockets for recreational and scientific purposes. Additionally, this website is aimed at establishing relationships and friendships with people and groups who share a similar interest in rocketry.
In Spanish language only.

Randy's Rocketry
The website of Randy Dormans, a fellow rocketeer that I have known for several years. Randy has a talent that has culminated in many awesome rockets and related hardware. He is currently working on a new "camera rocket" that is expected to soar to 18,000 feet.

Serge 77 - My Rocketry Workshop
In his web site, Serge documents his innovative experiments relating to many facets of amateur rocketry, including development of various propellants (mainly sugar based). Be prepared for many hours of enjoyable and rewarding reading. In Russian, but can be automatically translated into English.

Arabic Amateur Rocketry
My Moroccan friend Mohamed Elaouni has written an account of his experimental rocketry experiences. I have known Mohamed Elaouni for many years and helped him to get started. Despite meagre means and other challenges, his passion for rocketry and space exploration (which parallels my own) provided the impetus to overcome obstacles culminating the the construction and launch of his own modest self-built rocket. Written in Arabic.

The Jolley Rocket
Scott Jolley's web site devoted to the development of sugar based propellants for use in model/amateur rocketry. A must-see website to learn more about the reseach Scott has done on the various types of sugars (sorbitol, sucrose, dextrose, xylitol, erythritol, etc.). Scott's "claim-to-fame", however, is the discovery of how surfactants can make casting sugar propellants a breeze by reducing viscosity of the melted slurry. I have tried using his surfactant method with KNSB and found the effect to be dramatic -- the slurry flows like water, literally. Lots of other great information on sugar propellant research.

Raketgruppen IRA
Although this Swedish rocketry club is no longer active, their website is well worth a

visit. Raketgruppen IRA was formed in 1965 and was very active during the late 60's, 70's and 80's. Many of their rockets were technologically quite advanced and several flew to 4.5 km altitude. Well documented with numerous photos of launches and static firings, including video-clips of spectacular lift-offs.

ExRockets NEW
This website is a creation of fellow rocketry experimenter Dyanko Chernev which features several very interesting projects. Dyanko describes a rolling mill that he designed and built for making platinum foil. Platinum foil is used as an anode material in a perchlorate synthesis cell. Dyanko kindly fabricated some platinum foil for my own use, made from scrap jewelry which I provided, which has worked very well. Dyanko's electronic projects are impressive. He provides detailed instructions and schematics for those wishing to duplicate these projects. Included in the projects are : remote controlled launch firing system, thrust stand DAQ system, UV apogee detector, barometric apogee sensor, GPS data logger, tiny flight computer (similar to *Raven*), load cell amplifier, small digital accelerometer and more...! Dyanko's latest page explains the synthesis of potassium nitrate from calcium nitrate fertilizer. The method is relatively simple and produces a fine product well suited for making sugar propellant.
If you wish to be impressed, visit Dyanko's site.

General Rocketry, Engineering & Science

Dr. Robert Goddard -- rocket pioneer NASA, Goddard Space Flight Center

Orders of Magnitude -- A concise history of the NACA and NASA, 1915-1990. SP-4406

A Science Odyssey -- People and Discoveries, a databank consisting of 120 names of 20th century scientists and their stories, such as Albert Einstein, Wright brothers, Stephen Hawking, Rosalind Franklin, Edwin Hubble, J.Robert Oppenheimer, Charles Best, Francis Crick and other remarkable discoverers. People & Discoveries

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Resources

Online Scientific and Engineering Resource NEW -- I came across this website while searching for an electrical wire gauge table. This website has an abundance of useful and diverse resources including several online calculators. These include conversions of length units, energy, power, temperature, etc. Plenty of resources relating to mathematical concepts such as algebra, trigonometry, calculus and statistics. There's a useful page explaining electrical symbols. This is a website well worth checking out.
RapidTables

Rocketry Educational Guide -- Lots of great links to reports and web pages that deal with rocket stability, including Barrowman method, "cardboard cutout" method, extensions to the Barrowman equations, wind induced instability, purpose of fins, weathercocking, and a whole lot more. Apogee's Model Rocket Educational Guide

Rocketry Online --Comprehensive source of rocketry related material including HPR, model rocketry, as well as amateur experimental rocketry. Great links to useful software. Rocketry Online

Amazing Rocketry Facts, Quotes and Activities -- What exactly is rocketry? This webpage provides an introduction to rocketry and how model rocketry can serve as a basis for learning about science and engineering. Includes links to several resources for learning how to build model rockets as well as rocketry related classroom activities. Amazing Rocketry Facts, Quotes and Activities

Model Rocket Maintenance and Technology -- Good introduction to model rocketry including history, safety, and construction. Great links to useful resources. Rocketry Online

Parachute Prep & Packing Guide -- An excellent guide on how to pack a parachute into a rocket which will help ensure successful and tangle-free deployment.
Dura-Chute

Parachute Tips -- Calculating parachute drag, impact forces and terminal velocity.
Aerocon Systems

O-Ring Gland Design -- All the information you need to properly design O-ring glands ("grooves").
Allorings.com

Basic Metalworking NEW -- The webpage does a nice job of listing the basic metalworking tools that one needs to equip a home workhop. Add a metal lathe, and you're all set to delve into rocket making.
ASOS1.com

Materials Database -- Free online database of over 15,000 different materials such as metals, polymers and ceramics. This database provides detailed physical properties data, such as mechanical strength and thermal properties. MatWeb

MatWeb Weight Calculator allows for on-line weight calculation of metallic or plastic tubing and other shapes.

Chemicals Database --The NIST Chemistry WebBook provides users with free access to chemical, physical and thermodynamic property data for many chemical species. The data provided in the site are from collections maintained by the NIST Standard Reference Data Program and outside contributors. NIST Chemistry WebBook

Build Your Own Scale Models of JPL Spacecraft Galileo, Cassini, Mars Pathfinder, Mars Odyssey, Genesis, Near and other Jet Propulsion Laboratory spacecraft. *"An excellent way to learn more about a JPL space exploring machine, and its mission, is to build a scale model. Spend some time assembling one, and you'll be sure to know the spacecraft very well indeed! The scale models offered here have parts for you to download and print on card stock, instructions for putting them together, and links to mission information. Everything you need, such as white glue, scissors, etc. is listed. Some are quick and easy to assemble. Others require several hours' time and great care. Sometimes you'll find copies of these assembled models on the desks of engineers and scientists, using them for reference in their space mission. "*
JPL (California Institute of Technology)

Golden Days of Model Rocketry - Vern Estes Story
Although he is best known as the archetypical model rocketeer, it is important to recognize that Vernon Estes' foray into rocketry started out at the level of an amateur rocketry experimentalist. Vern's web site (http://www.vernestes.com/) contains a link to a fascinating three-part interview in which Vern (and his wife Gleda) describe the

"Golden Days" when they started their own company to develop and manufacture hobby rocketry supplies over 50 years ago. Included are detailed descriptions of "Mabel", the ingenious machine that churned out model rocket motors at a rate of one every 5.5 seconds. An interesting snippet reveals how Vern mistakenly deemed his model rocket motors as "engines", a term that has adhered to this day.
The Golden Days of Model Rocketry
Estes historical video footage

Video Links

Ecliptic Enterprises -- **Gallery of Videos** of the RocketCam™ aboard various launch vehicles...a must see!

Kirksville High School 2016 Rocket Project -- An adventurous school project that involved building and launching rockets powered by the F70 PVC rocket motor. Congratulations to the students and teachers who participated in this bold and successful initiative. The students clearly enjoyed this exciting challenge -- the effort put into their rockets is impressive, demonstrating that learning about rockets can be fun and educational. It is experiences such as this that sow the seeds of future rocket engineers and scientists...!
NEW Kirksville High School 2017 Rocket Project

Chemical Suppliers

Potassium Nitrate NEW -- Fertilizer-grade. Two reportedly good sources are:
VAS Agricultral Supply (located in Miami, Florida, U.S.A.)
Seed Ranch (located in Odessa, Florida, U.S.A.)

Sorbitol NEW -- Food grade granular sorbitol, available in 50 lb. bags. A reportedly good source is:
Round Eye Supply (Located in Lawrenceville, GA, U.S.A.)

Oshun -- Cosmetic ingredients & packaging supplier. Chemicals such as red iron oxide, black iron oxide, yellow iron oxide, ascorbic acid, chromium oxide, citric acid, clay, epsom salts are stocked by this on-line ordering company located in B.C., Canada. Minimum order is $100 CAD.

FIREFOX ENTERPRISES -- Vast selection of chemicals for rocketry and pyrotechnic needs (e.g. potassium nitrate & other oxidizers, sorbitol, dextrose, etc.), as well as other rocketry components, such as igniters, nosecones, body tubes, etc. Also a great selection of interesting and informative literature relating to rocketry.

Surfactant -- *Sodium Laureth Sulfate (SLS)* is a surfactant that is very effective in reducing the viscosity of propellant melted slurry, in particular KNSB propellant. SLS is an ingredient commonly used in soaps and shampoos.
Essential Wholesale and Labs
Voyageur Soap and Candle

Bakers Authority -- On-line source for sorbitol. Sold in 5 lb or 50 lb bags.

1-Stop-Sugarless-Shop specializes in sugar-free products and supplies. Seems they no longer carry sorbitol, but do carry Xylitol, Erythritol and Fructose.

HYDROPONICS.CO.NZ -- On-line source for Potassium Nitrate and other oxidizer chemicals in New Zealand.

Tool, Hardware & Rocketry Suppliers

Aircraft Spruce & Specialty Co. (Canada) or Aircraft Spruce & Specialty Co. (USA)-- Excellent source for aircraft-grade materials and supplies, such as composite materials and paraphernalia, hardware such as AN and NAS high strength fasteners, specialty rivets. Metalics such as sheet metal, brass tubing and thin-wall aluminum tubing (perfect for rocket bodies). Plastics such as delrin, acrylic and lexan sheet, PVC pipe and fittings. Great selection of steel products as well such as sheet, channels and strips. Good selection of 4130 alloy steel products including thin-walled 4130 tubing. Prices are generally reasonable. Great service with next-day shipping.

PRINCESS AUTO & MACHINERY -- I'm like a kid in a candy shop when I visit Princess ! Many of the items sold are surplus or used, so the prices are greatly reduced. Items includes all kinds of electric motors (AC & DC) including gearhead motors of all sizes, electrical and electronic components, power supplies, hardware including hi-strength fasteners, snap rings, O-rings, springs, roll pins, safety clothing, welders supplies, hydraulics and pneumatics, valves, pipe fittings, pressure gauges (great surplus selection), bargain priced machinist tools such as calipers, micrometers, rules, depth gauges, steel and aluminum, etc. All kinds of hand tools and hobbyist tools. Stock is always changing, so you'll never know what you'll find...on my last visit, I picked up half a dozen small (2') surplus parachutes ($3.50 ea.) and a 10' weather balloon ($10)! Over 20 locations across Canada. Purchases may also be made online.

METAL SUPERMARKET -- A good source of metal products (steel, aluminum, brass, etc.). This is where I usually shop for my metal supplies. They typically have a good selection of 'cutoffs' in 1018 mild steel and 6061 aluminum alloy (cheaper to buy cutoffs, which are sold by weight, rather than length). Locations in Canada, USA and UK. No minimum purchase.

CP TECHNOLOGIES -- CP Technologies publishes a bookset entitled *How to Make Amateur Rockets* that is sold to amateurs, junior high schools, high schools, universities, government agencies and contractors in the United States and around the world. CP Technologies sells supplies needed to make amateur rockets, such as propellant chemicals, motor making supplies, rocket body tubes, nosecones, fin material, rocket recovery electronic and more. CP Technology's motors are based on an ammonium nitrate/magnesium/polymer system.

OnlineMetals.com - The Small Quantities Specialist -- Source for a wide variety of metal products such as pipe, tubing, bar, sheet, plate, etc., including 6061-T6 alum. alloy tubing in sizes up to 5 inch diameter. No minimum order size, and purchases may be made online. Ship to Canada at reasonable rates. I have purchased some of my metal stock from Onlinemetals.com.

E-COM PLASTICS -- Source for all kinds of plastic material, including PVC rod, sheet and pipe. Minimum order size is $25 USD, and purchases may be made online.

BRAFASCO carries a vast selection of hardware, fasteners, adhesives, cuttings tools and more. Minimum purchase $10. Stores in Canada and USA.

MCMASTER-CARR -- Supplier of a vast array of hardware related products, such as: gaskets (including ceramic paper), plastic including PVC rod and pipe, tools (including micrometers and calipers), fasteners such as screws, bolts and rivets, O-rings, seals, welding rod, springs, lubricants, pipe and tube fittings, metals of all shapes and types, thermometers, heat-shrink tubing, and much, much more (370,000 products!). No minimum order size, and purchases may be made online. Prices are a bit high, but service is very good and fast, I usually receive my shipments in a couple of days. UPDATE: NO LONGER SHIPPING TO CANADA (apparently they can't be bothered, thanks to ITAR).

DIGI-KEY -- Great source for any kind of electronic parts, including microprocessors, IC's of all types, transistors, relays, switches, sensors, circuit boards, project boxes, battery holders, wire and cable, and a whole lot more. Purchases may be made online. A nice feature of online ordering is that you'll know immediately if an item is in stock. Service is great, I usually receive my shipment within a couple of days.

DATAQ Instruments -- Excellent quality and reasonably-priced data acquisition units. Perfect for collecting thrust and chamber pressure data when static-firing rocket motors. I have used several of their products.

Edmund Optics -- This is where I have purchased top quality first-surface mirrors for use with on-board video cameras. The mirror is mounted on the external surface of the rocket body, at a 45 degree angle to obtain an aft-facing view during flight. Edmunds carries a huge selection of mirror shapes and sizes, all at a decent price.

Hobbyking -- Hobbyking is an excellent source for lithium-ion batteries. Huge selection at good prices. I've purchased an assortment of lithium-ion batteries from Hobbyking that I use for on-board avionics, my launch controller and other rocketry applications. Hobbyking also sells a good selection of hardware such as tiny screws and other fasteners ideally suited to rocketry, including hard-to-find titanium screws.

Metal Working Machinery Tools
HARBORFREIGHT New metal lathes, $400 & up (U.S.A.)
SHERLINE $550 & up miniature lathes, milling machines, etc. (U.S.A. & Canada)
BUSY BEE TOOLS Good prices on "offshore" machinery tools. I bought my 12x24 metal lathe at Busy Bee in 2001 and still use it on a regular basis. Seven stores across Canada.
KBC TOOLS & MACHINERY Vast inventory of both high quality and reasonably priced "offshore" machinery tools & supplies. Excellent stock of specialized lathe bits such as needed for boring and snap-ring groove cutting. Stores in both Canada & USA.

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